UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/259,849	03/01/1999	PAUL A. FARRAR	303.557US1	5766

21186 7590 08/14/2003

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER
PERALTA, GINETTE

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 08/14/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/259,849	Applicant(s) FARRAR, PAUL A.	
	Examin r Ginette Peralta	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-77 and 185-189* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-77 and 185-189* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *31* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-17, 19-25, 27-32, 34-36, 38–44, 50-77, and 185-189 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. (U. S. Pat. 6,358,849 B1) in view of Brown et al. (U. S. Pat. 6,168,704 B1)

Regarding claim 1, Havemann et al. discloses a method of forming a conductor that comprises depositing an insulator *122* over a planarized surface *120*; etching a trench having a depth on the insulator *122*; depositing a barrier layer 150 on the insulator; depositing a seed layer *152* directly on the barrier layer; depositing a conductor on the seed area by a deposition process.

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the insulator, and depositing the conductor by a selective deposition process after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench having a depth on an insulator; depositing a barrier layer *400A* on the insulator; depositing a seed layer *400B* directly on the barrier layer; removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area; and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator, wherein a seed area is formed by the removal of the barrier and seed layers, and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer form selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents.

Regarding claim 2, Havemann et al. discloses depositing the barrier layer *150* by physical vapor deposition.

Regarding claim 3, Havemann et al. discloses etching the trench to a depth about equal to the depth of the insulator.

Regarding claim 4, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer *122* over a planarized surface *120*; etching a trench on the oxide layer *122*; depositing a barrier layer 150 on the oxide layer; depositing a seed layer *152* on the barrier layer without a layer between the seed layer and the barrier layer; depositing a conductor on the seed area by a deposition process.

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench having a depth on an insulator; depositing a barrier layer *400A* on the insulator; depositing a seed layer *400B* directly on the barrier layer; removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area; and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator, wherein a seed area is formed by the removal of the barrier and seed layers, and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer form selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents.

Regarding claim 5, Havemann et al. discloses that the oxide layer comprises a silicon dioxide.

Regarding claim 6, Havemann et al. discloses that the oxide layer is a fluorinated silicon oxide layer (col. 3, ll. 14-16).

Regarding claim 7, Havemann et al. discloses that the seed layer is deposited on the barrier layer by physical vapor deposition.

Claims 8-17, 19-25, 27-32, 34-36, 38-44, 50-77, and 185-189, recite the same steps as claims 1 and 4, however, with specific material limitations imposed on the layers recited, as specifically addressed in the following:

- Regarding the limitation that the insulator layer is made of a polymer, Havemann et al. discloses that as an alternative to fluorinated silicon dioxide, the dielectric layer can be made of organic polymers. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a

polymer instead of the fluorinated silicon oxide, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

- Regarding the limitation that the insulator layer is made of oxide is disclosed by Havemann et al..
- Regarding claim 10, it is well known to one of ordinary skill in the art that polymer (claim 8), polyimide (claim 9) and foamed polymer (claim 10) are equally good as interlayer dielectric (ILD). Therefore, substituting polyimide in Havemann's insulator layer 122 of Fig. 1 with foamed polymer is not an act of invention, and hence, unpatentable. *In re Ruff*, 256 F.2d 590, 118 USPQ 340, 343 (CCPA 1958). Unpatentability not only applies where equivalency is disclosed in the prior art, but also where such equivalency would have been obvious. Id. at 599, 118 LISPQ at 348. It would have been obvious to one ordinarily skilled in the art at the time the invention was made to select any one of these materials as a suitable insulator layer of Havemann's, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability (e.g., if low-k dielectric is desired) for the intended use as a matter of design choice. *In re Leshin*, 125 LISPQ 416.
- Regarding the limitation that the barrier layer is made of tantalum or tantalum nitride is disclosed by Havemann et al.. Furthermore, Havemann et al. discloses

that layer 152 is a copper seed layer formed directly on the tantalum nitride barrier layer.

- Regarding the limitation that the barrier layer is titanium is disclosed by Havemann et al..
- Regarding the limitation that the seed layer is made of copper is disclosed by Havemann et al..
- Regarding the limitation that the seed layer is made of gold or silver, is well-known in the art.
- Regarding the limitation that the conductive layer is made of gold, silver or aluminum, is well-known in the art.
- Regarding the limitation that the barrier layer and/or seed layer is deposited either by the PVD or CVD method is well-known in the art, as recited by Havemann et al..
- Regarding the limitation that the Al conductive layer is deposited on the seed layer by CVD is conventional, and hence well-known in the art.
- Regarding the limitation that the Al conductive layer is deposited to an amount sufficient to fill the trench is obvious as this shows that it is well known and desirable in the art of forming a plug or interconnect.
- Regarding the limitation that the copper seed layer is deposited to a depth of approximately five-hundred angstroms thick, or to five-hundred angstrom

below the top of the trench is trivial, since if it is deposited more than the specified amount, it is no longer a seed layer, but a conductive layer. Furthermore, Havemann et al. discloses that the copper seed layer is 10 nm thick.

- Regarding the limitation that the TaN barrier layer is deposited above the conductor to a depth of approximately five-hundred angstroms is an obvious matter of design choice within skill in the art that would not yield any unexpected results.
- Regarding the limitation that the barrier layer is deposited to a depth of between fifty angstroms and one thousand angstroms is well known to one of ordinary skill in the art. It would have been an obvious matter of design choice to vary the size of the barrier layer, since such a modification would have involved a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. *In re Rose*, 105 USPQ 237 (CCPA 1955).

3. Claims 18, 26, 33 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Brown et al. as applied to claims 1-17, 19-25, 27-32, 34-36, 38--44, 50-77, and 185-189 above, and further in view of Ting et al..

Havemann et al. as modified by Brown et al. discloses the claimed invention with the exception of the seed layer being formed of aluminum-copper, and the conductor being gold, silver or aluminum and being deposited by electroless plating.

Ting et al. discloses a method of forming a conductor that comprises a seed layer of aluminum-copper, the step of depositing copper on the seed layer that comprises depositing aluminum on the seed area by selective CVD, wherein the aluminum-copper layer is used as an alternative to a copper layer, and furthermore Ting et al. discloses that copper, gold, silver and aluminum are alternative materials for forming conductors. It would have been obvious to one having ordinary skill in the art at the time the invention was made to an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum or copper, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Response to Arguments

4. Applicant's arguments with respect to claims 1-77, 185-189 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703)305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703)308-49188-4918. The fax phone

numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

GP
August 11, 2003

SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER 2800